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THE CROW

IN ITS RELATION
TO AGRICULTURE



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THE CROW IS BEST KNOWN to the farmer for its pilferings in corn, sorghum, and other fields. Notorious also are its raids on outlying nests of turkeys and chickens. The sportsman views the crow as a menace to nesting game birds, both upland species and waterfowl. As increased attention has been focused upon these depredations, the public generally has come to look upon the crow with growing disfavor.

Unimpeachable evidence, however, shows that under many conditions the crow exerts a beneficial economic influence. Insects supply about one-fifth of its food, among those preyed upon being some of the worst agricultural pests—grasshoppers, caterpillars, and white grubs and their parents, the May beetles. Despite general belief to the contrary, the crow is esteemed in some farming sections.

Curbing the crow in its destructive tendencies, when necessary, but at other times permitting it to render the good services of which it is capable, appears to be the most reasonable attitude to assume toward the bird. Nation-wide, indiscriminate crow control is neither the answer to the problem of restoring waterfowl nor an economically sound procedure for protecting crops and poultry.

The illustration on the title page is from a drawing by the author.

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THE CROW IN ITS RELATION TO AGRICULTURE

By E. R. KALMBACH, *senior biologist, Section of Food Habits, Division of Wildlife Research, Bureau of Biological Survey*

CONTENTS

	Page		Page
Distribution and abundance.....	1	Food habits—Continued.....	
Nesting habits.....	3	Distribution of seeds.....	13
Winter roosts and migration.....	3	Summary of food habits.....	13
Food habits.....	5	Protection of crops and poultry.....	14
Animal food.....	5	Frightening devices.....	14
Insects.....	5	Deterrents.....	15
Crustaceans, reptiles, and other minor items.....	8	Coal tar.....	15
Wild birds and their eggs.....	9	Red lead.....	15
Poultry and their eggs.....	10	Other deterrents.....	15
Mammals.....	10	Scattering grain.....	16
Carriion and the distribution of live-stock diseases.....	10	Poisoning.....	16
Vegetable food.....	11	Trapping.....	17
Corn.....	11	Shooting.....	19
Other grains.....	12	Bombing roosts.....	19
Other crops.....	12	Destroying nests.....	20
Wild fruits.....	13	Crows as food.....	20
		Summary.....	21

THE CROW is practically omnivorous; it eats anything from the choicest poultry, the eggs of wildfowl, and the tenderest shoots of sprouting grain to mice, carriion, and weed seeds, many of which can offer but a morsel of nourishment. The bird's resourcefulness and its potentiality for good or harm are indicated by the fact that some 650 different items have been identified in its food.

Such diversity of food habits and the resultant variations in economic relations have led to irreconcilable differences of opinion regarding the crow's worth in the general scheme. Likewise, the changes in the past decade or two, both in agriculture and in the status of wildlife, have had a profound effect on the influence the crow exerts. Lastly there is increasing evidence that crow populations have shifted and have fluctuated locally in numbers. These facts combine to call for a restatement of the economics of the crow as in evidence today.¹

DISTRIBUTION AND ABUNDANCE

Although the common crow is so well known to farmers in the Eastern States that one would hardly suppose it could be confused with other birds, considerable uncertainty in identification exists in sections where it is scarce or where its range overlaps that of closely related species. Residents of the South Atlantic coast ordinarily make little distinction between the common crow and the fish crow—a bird of quite different habits; and the same lack of distinction

¹A comprehensive treatise entitled "The Crow and Its Relation to Man," by E. R. Kalmbach, based on the examination of 2,118 stomachs collected some years ago at various points throughout the country, was published in 1918 as Bulletin 621 of the U. S. Department of Agriculture. That report, though out of print, may be consulted in libraries.

is shown in the Southwest, where the small white-necked raven is frequently called a crow, and in some other parts of the West, where even the larger ravens have been similarly misnamed. All these birds belong to the same genus—*Corvus*.

Within the borders of the United States there are two species and six subspecies (or varieties) of crows. By far the most abundant and widely distributed form is the eastern, or common, crow (*Corvus brachyrhynchos brachyrhynchos*). This bird, together with four closely related varieties—the Florida (*C. brachyrhynchos pascuus*), the southern (*C. brachyrhynchos paulus*), the western (*C. brachyrhynchos hesperis*), and the northwestern crows (*C. brachyrhynchos caurinus*)—occupies a range comprising practically all the country east of the Rocky Mountains, as well as sections in the Northwest and along the western coast as far as southern California. It is found locally also in parts of Arizona and New Mexico. The other species, the fish crow (*C. ossifragus*), whose notes do not differ greatly from those of the young of the common crow, occupies a narrow strip along the Atlantic and Gulf coasts from Connecticut to Texas.

The white-necked raven (*Corvus cryptoleucus*), inhabiting arid and semiarid parts of Texas and southern New Mexico and Arizona, is the raven most frequently confused with the crow. This bird's slightly greater size, the white bases of its neck feathers, its tendency to soar in flight, its different notes, and its restricted range, however, serve to identify it. The northern raven (*C. corax principalis*), found along the Canadian border and at high altitudes farther south, and the American, or common raven (*C. corax sinuatus*), present in numbers in the States west of the Great Plains, may be distinguished by their greater size and by their hoarse notes, which possess none of the lusty, open-throated quality of those of the crow.

In this bulletin the name crow has been used to include the five forms of the common crow—the eastern, Florida, southern, western, and northwestern varieties. The food habits of all are essentially the same, differing only to the extent occasioned by the varying character of the food supply in the different parts of their ranges. In some of the Western States, where the crow appears only as an occasional breeder, it has little economic significance, as in Nevada and the greater parts of Arizona, New Mexico, Colorado, Utah, Wyoming, Idaho, and parts of Oregon and Washington. It is abundant only locally in California and is not numerous in large areas in Montana, North Dakota, and South Dakota, or in the Gulf States of Florida, Alabama, Mississippi, Louisiana, and Texas. On the basis of average abundance throughout the year, the crow exerts its greatest influence on agriculture in the Atlantic Coast States north of North Carolina and in the central and upper Mississippi Valley. In winter the bird is most important in Kansas, central Oklahoma, and north-central Texas.

Judging from the increased number of crows and the size of their winter roosts in the central and western part of the United States during the past half century, the center of the crow population appears to have gradually shifted westward. Extension of agriculture in the Prairie Provinces of Canada and an increase in the grain-sorghum acreage in Kansas and Oklahoma may have induced this movement.

NESTING HABITS

The nest of the crow is commonly built at heights of 20 to 60 feet and is usually well concealed from below by foliage. It may be placed in the dense top of a pine, but oaks and elms of the river bottoms and, in the West, cottonwoods are equally acceptable. Nests are rarely found in deep forests. In the East the hilly and partly wooded sections of New Jersey, New York, and Pennsylvania seem best to meet nesting requirements; in Ohio, Indiana, and Illinois the low, fertile river bottoms are especially attractive; and farther west limited tree growth confines nesting activities to the neighborhood of streams. Near the northern edge of its breeding range the crow may nest close to or even on the ground.

Crows raise annually one brood of 3 to 7 young. In the Southern States the young may be found in the nest as early as the middle of March, and farther north correspondingly later, so that along the northern tier of States they may be present as late as July. The young birds stay in the nest about 3 weeks. For some time after the brood has left the nest, in July, August, and September, crows may be found in family parties or in small, loose flocks of 10 or 12, feeding largely on grasshoppers and ripening corn, or, in the Prairie Provinces of Canada, upon waste grain in stubble fields.

WINTER ROOSTS AND MIGRATION

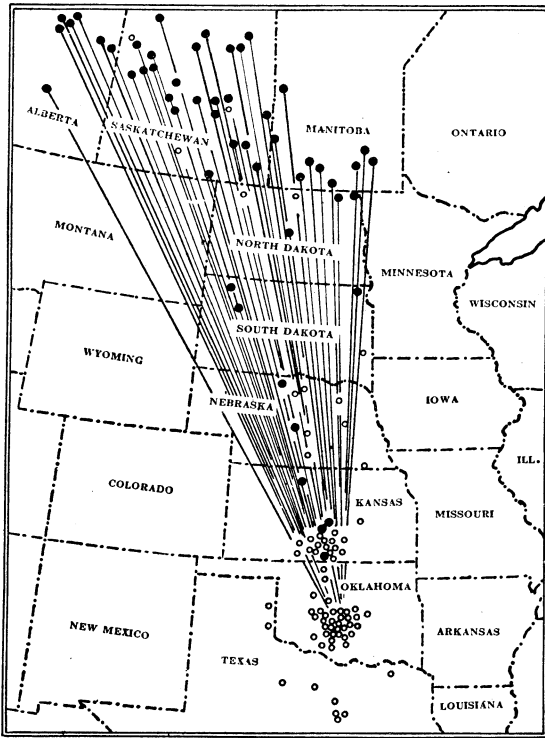
Although crows are more or less clannish, even in the nesting season, their gregarious habit is most highly developed during the colder months, when, often by tens of thousands, they resort to nightly roosts. This flocking is of considerable economic significance in that it results in gatherings of large numbers of birds of potentially injurious habits. Some of the roosts are well established by the end of September, and by midwinter the combined southerly migration and gregarious habits of the birds have brought together in comparatively small areas the bulk of the crow population of North America.

On the Atlantic seaboard the States from Connecticut to Virginia harbor crows in large numbers during the winter months. Many thousands are supported in the Mississippi and Ohio River Valleys, the southern parts of Indiana and Illinois, parts of Kentucky, and in Missouri. Some of the largest crow roosts on this continent may be found in south-central Kansas, the sorghum-raising sections of central and western Oklahoma, and contiguous parts of Texas to the south, while, farther west winter concentrations occur in southern Idaho, eastern Oregon, and the coastal sections of Oregon and Washington.

That these winter aggregations are composed largely of birds that nest to the northward has been a matter of general and well-founded belief for many years. Yet the extent of this seasonal migration and its significance in problems of game management and crop damage have not been fully appreciated.

In recent years the banding of crows on their wintering grounds has yielded undeniable evidence of their pronounced seasonal movements. It has demonstrated that whatever benefits may accrue to other nesting birds by reason of a curtailment of the number of

crows in winter roosts will be manifest not in the areas of their winter sojourn but at points to the north, some of them perhaps distant. Apparently the entire crow population participates in these seasonal shifts. Crows may both winter and breed in the South, and, likewise, they may both winter and breed in more northerly States, but in either case the breeding ground is north of the wintering area. The crows wintering in Oklahoma, for instance, breed near the northern edge of agriculture in the Prairie Provinces of Canada, and most of these birds travel from 1,200 to 1,500 miles in going from their winter to their summer home. This fact is illustrated in figure 1, where are shown the points of recovery of 125 of



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FIGURE 1.—Return records of 125 of 714 crows captured, banded, and released at Norman, Okla., during the winter of 1935-36. Solid black dots indicate points where 51 birds were recovered in the spring and summer (April to August, inclusive), and the circles, the points of recovery of 74 birds in the fall, winter, and early spring (September to March, inclusive).

714 crows that were captured, banded, and released at Norman, Okla., during the winter of 1935-36, by Shaler E. Aldous, of the Biological Survey.

Of the 125 recoveries of these crows banded during the winter in Oklahoma, not one was made in that State during the breeding or summer periods. Those killed in Oklahoma were obtained in the fall, winter, or early spring months. This was true also of the birds recovered in Texas and of most of those collected in Kansas.

It was apparent that some of the crows recovered during spring and summer in Kansas, Nebraska, and the Dakotas were shot while on their way to more northerly breeding grounds and that these birds might have nested in

Canada had they not been killed en route. Of outstanding significance, however, is the fact that 39 of the 51 birds recovered during spring and summer were shot in Canada. All these were taken in a relatively narrow area extending from eastern Manitoba to central Alberta, paralleling the northern border of agriculture in the Prairie Provinces.

The returns clearly reflect the crow concentration that exists in these Canadian areas in the spring. In the writer's experience such a density of breeding crows is not found anywhere in this country.

It will be seen, therefore, that whatever influence the crows wintering in Oklahoma may have on other breeding birds and on insects during the spring and summer is exerted largely in Canada. Few, indeed, of these winter crows remain in Oklahoma to breed. The summer residents of that State possibly pass the winter still farther south. Additional banding work is needed to demonstrate this fact fully. Further banding also is desirable, particularly of crows wintering in more westerly States (Colorado, Idaho, Oregon, and California) to reveal the relationship of these birds to the crow populations that pass the summer in British Columbia and other parts of western Canada.

FOOD HABITS

What a bird eats or does not eat is the first question to be answered in an inquiry into its economic status. For an accurate determination of the various items in its diet nothing has been found more reliable than the examination of stomach contents. In the analysis made by the Biological Survey some years ago of a series of 2,118 stomachs of crows collected in 40 States, the District of Columbia, and several Canadian Provinces, mostly from farming districts, 1,340 stomachs were those of adult crows and 778 those of nestlings. The following discussion of the food of the crow, with accompanying percentages of food items (figs. 2 and 3, and tables 1 and 2), is based on that earlier examination, which it is believed is still adequate for a general appraisal of the bird in agricultural sections of this country.

ANIMAL FOOD

About 28 percent of the yearly food of the adult crow is animal matter and consists of insects, spiders, millipeds, crustaceans, snails, the remains of reptiles, amphibians, wild birds and their eggs, poultry and their eggs, small mammals, and carrion.

INSECTS

More than two-thirds of the animal food of the crow, or about a fifth of its whole diet, is composed of insects, among them many of the most destructive agricultural pests. The crow is primarily a terrestrial feeder. Its insect diet, therefore, is made up almost exclusively of species the bird finds on or near the ground or obtains from beneath the surface by turning over sticks, clods of earth, or dung. This is a method of feeding employed diligently by the crow from early spring till the beginning of fall, when the usual crop of grasshoppers furnishes a more accessible food supply.

Beetles of various kinds constitute about 7.5 percent of the crow's yearly food. These insects are a promiscuous lot, some beneficial, some neutral, and others, the major portion, highly injurious. Among these are May beetles and their larvae, the white grubs; also click beetles and their young, the wireworms; weevils; and some of the ground beetles that have vegetarian food habits. Orthoptera, that is, grasshoppers, locusts, and crickets, form 7.33 percent of the food. The damage such insects inflict far exceeds that done by the

beetles. The short-horned grasshoppers especially are destructive, and, though these insects have never been such serious pests in the Eastern States as in some parts of the West, the annual toll they take from farmers throughout the country amounts to many millions of dollars. In August and September, grasshoppers form nearly a fifth of the crow's food. Caterpillars form about 1.5 percent of the diet of the adults; nearly four times as much, however, is fed to nestlings. Other insects, including bees, wasps, ants, flies, and true bugs, are taken in only small quantities, and the economic problems involved are not important.

The numbers of the various insects eaten during different months of the year are often indicative of their period of abundance. Early in spring, for instance, few May beetles or other scarabaeid beetles are eaten, but by April they form about 5 percent of the crow's food, and in May the peak abundance of May beetles is indicated by the fact that they compose 20.99 percent of the bird's diet (fig. 2 and table 1). Likewise the monthly increase of grasshoppers from May to September is shown in the crow's food, in which these insects constitute approximately 4, 6, 14, 19, and 19 percent of the food taken. The height of the caterpillar season also is indicated by approximate percentages of 1, 3, 6, and 2, for April, May, June, and July, respectively.

TABLE 1.—Monthly percentages of the principal food items of the adult crow

Kind of food	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
May and other beetles.....	0.18	1.19	1.04	4.98	20.79	10.06	4.47	5.26	0.91	0.54	0.77	1.17	4.28
Ground beetles.....	.07	.10	.26	2.30	5.54	3.24	2.13	1.76	2.31	.14	.74	.19	1.56
Grasshoppers.....	.51	1.14	.56	1.84	4.29	5.83	14.04	19.14	19.24	8.68	10.73	2.07	7.34
Caterpillars.....	.18	.41	1.36	1.13	2.71	6.41	1.95	.62	2.12	1.19	.30	.39	1.56
Miscellaneous insects.....	.35	2.01	1.36	4.47	6.44	10.41	11.26	8.29	3.06	.96	1.62	.67	4.23
Carrion.....	8.95	2.45	2.66	5.24	2.13	1.48	.29	.95	2.69	.32	1.44	2.37	2.58
Other miscellaneous animal matter.....	4.70	3.67	8.81	14.13	10.56	9.55	10.14	3.38	1.99	2.46	3.14	6.32	6.57
Corn.....	51.95	43.19	36.85	35.28	33.26	20.53	9.13	17.96	29.60	54.33	63.93	65.00	38.42
Other grain.....	7.00	9.74	34.22	20.90	8.43	10.20	20.22	22.80	8.33	7.08	2.67	.89	12.70
Cultivated fruit.....	2.55	3.42	.26	2.74	.91	14.12	9.31	5.79	1.66	2.40	.07	1.36	3.74
Wild fruit.....	19.76	19.57	10.65	5.06	3.49	7.28	14.05	13.67	25.82	20.50	12.94	14.75	13.96
Weed seeds and rubbish.....	3.80	13.11	1.97	1.93	1.45	.89	3.01	.38	2.27	1.40	1.65	4.82	3.06

The size and the voracious appetite of the crow make this bird especially valuable in times of outbreaks of one or another of the insect pests upon which it feeds. In the stomach of a crow collected in April were the remains of 85 May beetles, and even as many as that formed less than half the contents; in another were 72 wireworms; and in a third were fragments of 123 grasshoppers. Twelve birds in a series collected in Manitoba had averaged about 57 grasshoppers each, and 1 from Michigan had eaten 483 small caterpillars. Nestling crows, whose rapidly growing bodies require even greater quantities of insect food than are taken by the adults, often excel their parents in the good work of insect consumption. One brood of 4 had been fed 418 grasshoppers, and another brood of 7 had made away with 585 such insects during a few hours before the birds were collected. Of 157 nestling crows obtained in Kansas in 1913, 151 had

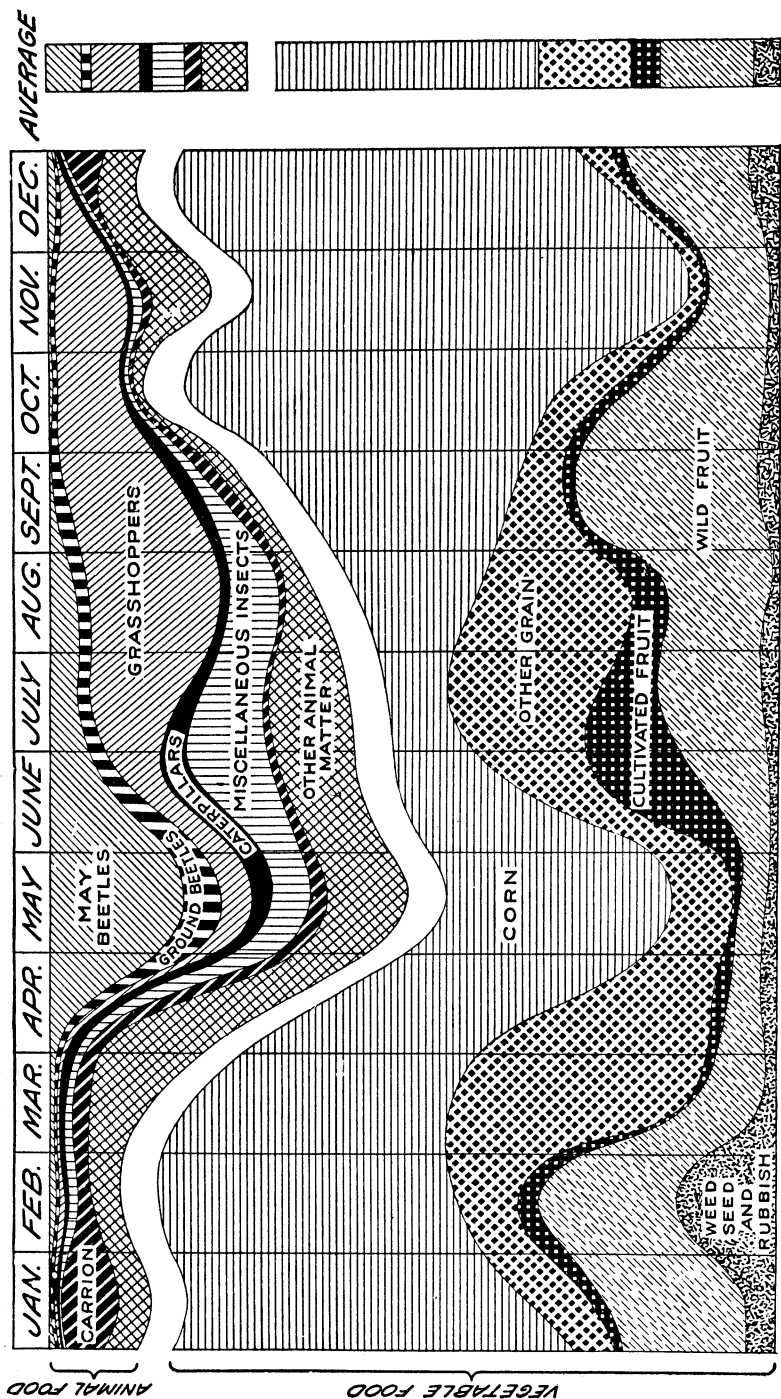


FIGURE 2.—Relative volume of the food by months of 1,340 adult crows collected in agricultural sections, and the average of each item in the yearly food. Percentages for each are shown in table 1.

been fed grasshoppers. Caterpillars, always a favorite source of food for nestling birds, were present in more than a third of the 778 nestling-crow stomachs examined.

Summing up, it may be said that the character of the insect food of the crow leaves little to be desired and constitutes the strongest argument in the bird's favor. While fully applicable to the adult birds, this statement is doubly true of the nestlings (fig. 3 and table 2).

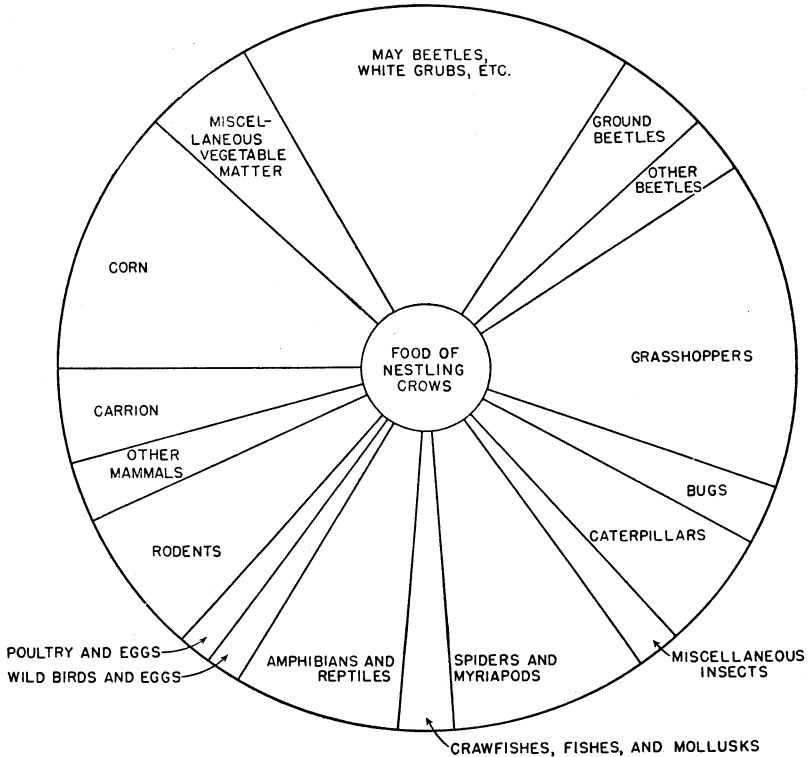


FIGURE 3.—Food of 776 nestling crows collected mainly in farming sections. The percentage of each item is shown in table 2.

TABLE 2.—Percentages of the principal food items of the nestling crow

Food items	Percent	Food items	Percent
May beetles	17.44	Fishes and mollusks	0.68
Ground beetles	3.90	Amphibians and reptiles	7.04
Other beetles	2.59	Wild birds and eggs	1.57
Grasshoppers	14.60	Poultry and eggs	1.60
Bugs	2.61	Rodents	6.22
Caterpillars	5.34	Other mammals	2.61
Miscellaneous insects	1.88	Carrion	3.95
Spiders and myriapods	9.68	Corn	11.91
Crawfishes	1.78	Miscellaneous vegetable matter	4.58

CRUSTACEANS, REPTILES, AND OTHER MINOR ITEMS

The crow's animal foods other than insects includes items that reflect some of the bird's less admirable habits. To its credit is the

consumption of millipeds, crustaceans, mollusks, certain fishes, and carrion, but its destruction of beneficial spiders, toads, frogs, and small snakes is against the bird. Fortunately, the quantity of such material eaten is small, slightly more than 1 percent of the yearly food.

WILD BIRDS AND THEIR EGGS

Because of its depredations on small wild birds and its destruction of the eggs of larger game species, the crow has been condemned both by bird lovers and by sportsmen, and stomach examination has, to an extent, sustained their charges against the bird. As determined by the examination of stomachs collected in agricultural sections in the United States, about a third of 1 percent of the annual food of adults and 1.5 percent of that of nestlings is derived from wild birds and their eggs, and about 1 in every 28 adult crows and 1 in every 11 nestlings examined had eaten such food. The ratio of nestlings, however, gives an exaggerated idea of the predation, as several members of a brood often are fed parts of the same victim.

An examination of crows collected in 1934 and 1935 in the Prairie Provinces of Canada, in close proximity to nesting waterfowl, gave a somewhat different result. Adults took on an average during the specified seasons 4 times the quantity of other birds and their eggs that those in the United States did; and the nestling Canada crows took 6 times the quantity eaten by the young in this country. On the basis of the frequency of such predation it may be said that in Canada the adult crow is 10 times, and the nestling crow 6 times as culpable as their counterparts in the United States. This pronounced record of bird-and-egg destruction by crows in Canada was due primarily to the fact that all the birds collected were taken in close proximity to nesting waterfowl, almost to the total exclusion of any obtained in agricultural sections.

Field studies conducted at the same time disclosed the fact that in these areas, selected to show the crow at its worst and where adults obtained 4 percent and nestlings 10 percent of their sustenance from other birds and their eggs, 31 percent of 512 duck nests under observation were destroyed by crows. In appraising the continent-wide problem of crow-waterfowl relationships, it must be recalled that the crow abounds only in a part, possibly a sixth, of the waterfowl breeding areas of Canada and Alaska and that the aggregate egg loss, if prorated for the entire waterfowl population of North America, would be considerably less—possibly not more than a tenth of the eggs laid. Elsewhere, however, egg losses may locally be approaching those indicated by these studies in Canada. This involved problem is treated in greater detail in Circular 433, *Crow-waterfowl Relationships, Based on Preliminary Studies on Canadian Breeding Grounds*.

Observations on the Lower Souris Refuge in North Dakota in 1936 and 1937 showed that the crow is not an outstanding hazard to waterfowl there. Only 1.7 percent of the 351 nests studied in 1936 were destroyed by crows, while in 1937 these birds preyed upon 3.4 percent of 566 nests under observation. Even with this latter rate of loss, the crow on this refuge is at present considered to be a minor hazard to breeding waterfowl. Nevertheless, in areas dedicated pri-

marily to the restoration of waterfowl, in suburban districts where small birds are favored, and on game farms, rational crow control is warranted.

POULTRY AND THEIR EGGS

The crow's depredations on poultry and their eggs are governed largely by local conditions. The proximity of a crow's nest containing a brood of voracious young, unusual accessibility of poultry, and the overdevelopment of this obnoxious habit in certain individual birds are factors accountable for most of the losses to poultry raisers from crows. Reports of striking similarity often come from widely separated localities, while circumstances diametrically opposite have been reported from neighboring farms. Poultry and their eggs form an extremely small part of the annual diet of the crow, less than 1 percent (0.57) of the adult's and 1.6 percent of the nestling's. As in its preying upon wild birds, the crow's visits to the poultry yard are most frequent when it has young to feed; as a consequence, successful protective measures undertaken in April, May, June, and July will reduce to a minimum the crow's depredations on poultry. How to reduce these losses is described in Leaflet 96, *Protecting Poultry From Predaceous Birds*.

MAMMALS

In feeding on mammals the crow supplements the good work of hawks and owls by tending to suppress rodent pests, which form 1.6 percent of the diet of adult crows and 8.8 percent of that of the nestlings. Young cottontail rabbits are the crow's favorite mammal food. Though the bird sometimes does molest young lambs, swine, and other livestock, this seems to be only when it is occasionally hard pressed for food. Fortunately attacks on stock are not common, and losses of this kind are negligible, much less than those resulting from the depredations of magpies and ravens.

CARRION AND THE DISTRIBUTION OF LIVESTOCK DISEASES

As a carrion feeder the crow ably supplements the good work of turkey buzzards and gulls, especially along riverbanks and tide flats, where dead fish supply animal matter much needed by the bird during winter. Because of its carrion-feeding habits, the crow has been accused of being a potential agent in the transmission of livestock diseases, especially hog cholera. No doubt the transmission of this disease by the crow is possible, either by carrying virus adherent to the feet, bill, or other parts of its body or by depositing infected excreta after the bird has fed on the body of an animal that died from the disease. By immediately burying the dead bodies of diseased animals, however, the attraction to these birds may be eliminated. It is well to add that dogs, cats, insects, and many other agents in the spread of such diseases may be as effective in the dissemination of germs as are crows. All these agents can be made to a large degree innocuous by thorough sanitation—burying or otherwise disposing of the carrion. The extermination of the crow would eliminate only one of many means by which such diseases may be spread.

VEGETABLE FOOD

CORN

Nearly 72 percent of the adult crow's yearly food is vegetable matter, more than half of which consists of corn. In November, December, and January this grain contributes more than half the total food, but most of it is waste gleaned from scattered kernels and unharvested ears. During the sprouting season, in April and May, corn constitutes about a third of the food, and at harvesttime, in October, it again supplies some 50 percent. Of 1,340 adult crows collected in varying numbers in every month of the year, 824 (about 61 percent) had fed on corn. Some farmers believe that depredations on sprouting corn are due largely to pressure of foraging for the nestlings. Stomach analysis, however, reveals that corn forms less than an eighth of the food of young crows, or about one-third the proportion taken by the adults at the same time.

Injury to this crop may be either to sprouts, to corn in the milk or in the roasting-ear stage (fig. 4), or to the ripened grain that has been stacked in shocks. Of these, the last is the least serious. The pulling of sprouting corn sometimes results in heavy losses, but the use of coal tar and other deterrents on the seed has lessened these losses, especially in small, isolated fields. Damage to ripening corn is the most vexatious form of depredation on this grain of which the crow is guilty. It is not so much the quantity of corn the bird actually eats at this time that makes such attacks so objectionable as it is the subsequent injury resulting from water entering the ears from which the husks have been partly torn.

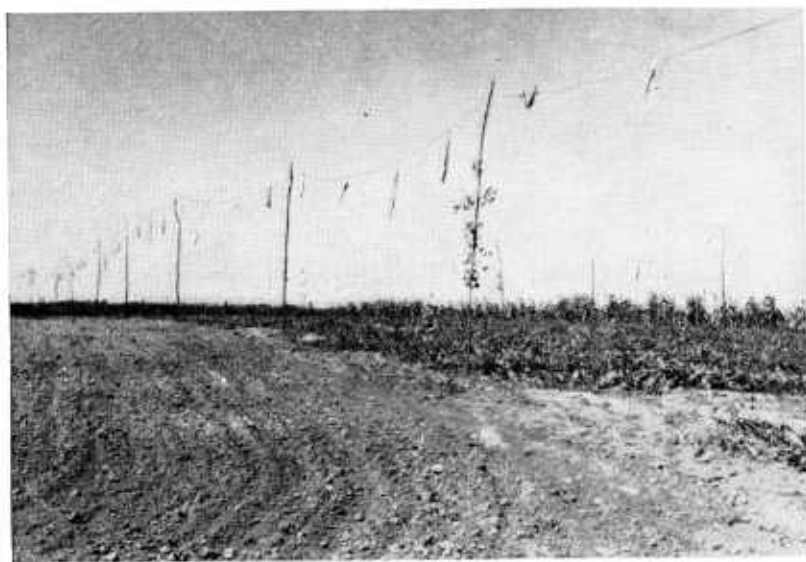


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FIGURE 4.—Corn damaged in August by crows in Ohio.

OTHER GRAINS

Of the smaller grains, together forming about an eighth of the food of the adult crow, wheat is the favorite. It was present in 227 of the 1,340 stomachs examined and apparently replaces corn in the crow's diet in the Northwest and other regions where that grain is not raised extensively. When attacks upon wheat are made at sowing or sprouting time, the depredations of a single crow may be of considerable consequence. Oats are eaten far less frequently than wheat, and considering that waste oats are available at all times of the year in horse droppings, the quantity of this grain in the diet of the crow need not much concern the farmer.



B44562

FIGURE 5.—Field where crows were pecking holes in mature watermelons—the patch was surrounded by wire to which rags were attached to frighten the birds away.

In the grain-sorghum areas of Kansas and Oklahoma, crows have become increasingly troublesome during the past two decades, largely because of their increased number in winter, when they feed extensively on late-maturing varieties of the grains. Late planting and insufficient moisture or other adverse climatic conditions at times result in shocked sorghums being left in the fields until after the first of the year. When this occurs damage by crows is almost certain to result in the vicinity of large roosts.

In some States buckwheat is occasionally eaten, but by far the largest part of this grain in the crow's diet is waste.

OTHER CROPS

A number of other crops are subject to occasional damage by crows. In the Southern States depredations on ripening watermelons (fig. 5) have sometimes resulted in heavy losses locally. In southern Okla-

homa and in Texas pecans and peanuts are often damaged. Measures for the protection of the pecan crop, much of which is harvested from wild trees, are of little avail where crows are abundant. Apples and almonds are less frequently injured; while the aggregate losses to beans, peas, figs, oranges, grapes, and cherries are not important.

WILD FRUITS

Only about 14 percent of the adult crow's sustenance is at present derived from wild fruits and nuts, from which the species must originally have obtained most of its vegetable food. This part of its diet is obtained from many sources but chiefly from acorns and fruits of the various sumachs, poison-ivy and poison-oak, bayberry, dogwood, sour gum, wild cherries, grapes, Virginia creeper, and pokeberry.

DISTRIBUTION OF SEEDS

The mere consumption of wild fruits by the crow involves nothing of economic importance. In using these foods, however, the bird's digestive processes destroy practically none of the embryos of the seeds, and crows thus act as important distributors of certain plants, some of which, as poison-ivy and poison-oak, are particularly noxious. In this work, however, crows only supplement the activities of the many other native birds that feed on these seeds, often to a greater extent than crows do. Furthermore, as they eat most of these seeds during the winter, a large quantity of regurgitated seeds are deposited at the roosts, often in dense stands of timber, where the chances for sprouting are slight. Distribution of desirable fruits by the crow also must be regarded as offsetting in part its planting of noxious species.

SUMMARY OF FOOD HABITS

The consumption of insects presents the strongest argument in the crow's favor. About a fifth of its diet is obtained from the insect world, and among the pests it destroys are some of the most troublesome with which the farmer has to deal. Many of the insects it eats are taken early in spring, when their life cycles are at the lowest ebb and their destruction results in the greatest good. Conspicuous among such food items are May beetles and their destructive larvae, the white grubs, of which the crow is an effective enemy. In its consumption of grasshoppers the bird probably renders man its greatest service; in regions where these insects are abundant their nymphs form the principal insect food of the nestlings. Other creatures in the consumption of which the young exceed the adults include caterpillars and spiders. The latter, however, are predaceous and to some extent beneficial.

The crow's feeding on reptiles and amphibians is on the whole not to the best interests of man, but fortunately the highly beneficial toads are found in the crow's food less frequently than the less useful frogs and salamanders. In feeding on the eggs and young of birds the crow commits an offense that may be serious in the vicinity of game farms, refuges, and waterfowl areas under management. There the bird must be held in check if the managed species are to thrive in concentrated numbers. It is not believed, however, that even the total elimination of the crow, which is present in destructive num-

bers on only part of the productive breeding area of waterfowl, would materially affect the continental supply. This subject is discussed in the circular already mentioned (No. 433) on crow-waterfowl relationships.

The molesting of poultry by crows is an injurious habit against which protective measures are effective. Properly screened enclosures for young chicks and suitable housing for sitting hens will obviate most of the losses. In its feeding on small mammals, its annoyance of young livestock, and its consumption of carrion, the crow has tendencies about equally divided between good and bad. The accusation that the bird is a dominant factor in the distribution of livestock diseases has little substantiating evidence.

Of the vegetable food, corn is the principal item. It is the crow's staff of life, furnishing more than 38 percent of the annual sustenance. In the consumption of this grain the bird comes in most frequent conflict with the farmer. Much of the corn eaten, however, is taken from October to March, when waste grain necessarily forms a large part of the supply. Coal tar and other deterrents on the seed have lessened losses to sprouting grain, especially in small, isolated fields, but, the corn crop in the roasting ear is subject to destructive attacks difficult to prevent. The crow also levies a toll on sorghums, wheat, and other small grains; melons are subject to attack; and even cultivated fruits are sometimes damaged.

The offenses of which the crow has been accused outnumber its good deeds, but this does not mean that these offenses are of greater importance. Many of the crow's depredations may be lessened or entirely prevented by protective measures, whereas in preying on insects it does work that can ill be spared. Although an overabundance of crows is not in the best interests of the farmer, their extermination would remove a most effective enemy of certain insect pests. Control measures are justifiable locally where numbers of crows take more than a fair share of the crops in return for services rendered; in other sections where the birds are in normal abundance they may well be allowed to remain unmolested.

PROTECTION OF CROPS AND POULTRY

FRIGHTENING DEVICES

It is not necessary to describe in detail the many well-known devices employed as scarecrows. The time-honored straw-stuffed human effigy is the one most frequently used, though often it fails to accomplish its purpose. Frightening devices that sometimes are successful include windmills operating a noise-producing mechanism, newspapers placed on the ground, twine stretched about and across fields (fig. 5) from poles set at intervals around them, bodies of dead crows hung in conspicuous places, and various unusual objects, as pieces of shining tin moving in the wind or glass bottles hung about fields. Poultry yards especially have been protected from the ravages of crows by strands of cord stretched across at intervals at a height of 6 to 8 feet from the ground. One or another of these methods has met with varying success on occasion, but sometimes none will produce the desired results.

DETERRENTS

Damage by crows to corn and other grains at sprouting time may be lessened by special treatment of the seed. Although the application of deterrents to the seed involves additional labor at planting time and may tend to retard germination in periods of dry weather, the relief many farmers have had from crow depredations by their use warrants description of the methods used.

COAL TAR

One of the most successful crow deterrents is coal tar, which is a cheap byproduct in the manufacture of illuminating gas and may be obtained at gas works or paint shops. It is a dark, heavy liquid of about the consistency of thin molasses. The grain treated with it emits a strong, gassy smell for some time, even after it has become thoroughly dry. When used in the quantities here recommended, coal tar does not prevent seed germination. This important qualification is not possessed by certain other substances sometimes recommended as crow deterrents. Experiments have shown that in periods of normal rainfall germination is but slightly retarded by the coal-tar treatment, though in periods of drought the retardation may be several days.

Coal tar should be used in the proportion of about a tablespoonful to half a bushel of seed grain which has been previously heated in warm water and then drained. Continued stirring of the tar with the grain will eventually result in an even coating. The seed may then be spread out on a dry surface or may be dried by mixing it with a moderate quantity of an absorbent medium, as ashes, land plaster (gypsum), or powdered earth. When thoroughly dry, the seed may be used in a planter.

Deterrents are commonly used by farmers in the North Atlantic States and, to a lesser degree, in the South Atlantic States. In the extensive corn-raising region of Illinois, Iowa, and Missouri, the grain is seldom tarred, probably because it is planted on so large a scale that losses to the individual farmer are less severe.

RED LEAD

Another substance used as a deterrent is red lead. This appears to have been first employed in Europe, where it met with considerable success. The grain is given a thin glue sizing and is then drained and dusted with red lead until well-colored. Though this process has been little used in this country, its success in Europe warrants further trial here.

OTHER DETERRENTS

In a series of experiments with deterrents conducted at the Kansas Agricultural Experiment Station the effect of various substances upon the germinating powers of the seed was investigated. In his report on this work, Theo. H. Scheffer, in a circular (No. 1) of the Kansas station, stated that kerosene, crude petroleum, copperas, crude carbolic acid, fish oil, and spirits of camphor, used in sufficient quantity or strength to impart an odor to the corn, seriously injure

its germinating powers; and that to treat the seed with any of these materials in such small quantity or dilute form as not to injure the germ is useless, for the slight taste or odor imparted is soon dissipated in contact with the soil.

Similar experiments, conducted in 1909 by B. M. Duggar and M. M. McCool at the New York (Cornell) Agricultural Experiment Station (reported on in Circular No. 6, of that station), indicated that of a number of deterrents employed, turpentine emulsion and an anilin-oil solution seriously affected germination.

The proprietary manufacture of deterrents for use on seed grain has been undertaken on a moderate scale in this country, and a few brands also have been imported. Most of these apparently use coal tar or closely related products as a base; one at least contains a copper salt and is poisonous; while any merit that another imported deterrent may have seems to be that the treated seed is a brilliant blue. None of the proprietary products tested by the writer had any harmful effect on the seed; but there is no evidence that any of these manufactured substances is superior as a deterrent to coal tar properly applied.

SCATTERING GRAIN

Many farmers have had considerable success in protecting their sprouting corn by spreading broadcast over the fields a quantity of grain previously softened with water. This the birds take, leaving the planted grain untouched. A comparatively small quantity sacrificed in this way during the short period of a week or 10 days when sprouting corn is subject to damage has reduced the loss to the growing crop.

POISONING

That poison (strychnine) serves a useful purpose in the control of certain vertebrate pests cannot be denied, and its utility in the control of crows has been the subject of considerable experimentation and study by the Biological Survey. Recommendations for its guarded use have been made, not so much as a means of killing large numbers of the birds as for the deterrent effect on flocks of crows suffering the loss of one or several of their number through feeding on poisoned baits.

Although strychnine is approved for use in control work because of the marked resistance to its toxic action possessed by gallinaceous birds, including pheasants, quails, and domestic chickens, the Biological Survey has frequently pointed out the dangers connected with its careless use. Observance of local regulations governing the distribution of poison also has been stressed.

The failure of strychnine as an effective poison for killing large numbers of crows economically is due to its quick action, which often causes individuals of a flock to show the effects of the poison before an appreciable number have eaten the bait. Although this may result in crop protection in the immediate vicinity, through the frightening effect, seldom are large numbers of these wary birds killed.

Experiments have been made with poisons possessing slower action, but none was found that was relatively nontoxic to any large group of birds. No difficulty is experienced in killing crows economically with slow-acting toxins, but they have to be so carefully handled as to make their use by the general public impractical. Even under

the close supervision of experienced workers, slow-acting poisons exposed in places where they would be readily available to crows may be hazardous to beneficial forms of wildlife. For this reason the Biological Survey has refrained from recommending their use by farmers generally, particularly in the control of birds that require open exposure of baits.

Since a quick-acting poison (strychnine) is ineffective in large-scale operations and a slow-acting poison is too dangerous for general use, the utility of poison baits in crow control is limited largely to local situations where the deterrent action produced by killing a few birds will result in a measure of crop protection. In the face of these limitations and objections and in conformity with the policy of the Biological Survey to limit the use of poison in the control of birds strictly to those situations where there is no other satisfactory procedure, emphasis is here placed on trapping, shooting, and other methods of relief from crow depredations.

TRAPPING

Trapping may be employed to advantage by using either steel traps to capture individual marauders or cage traps of the Australian type (fig. 6) to take larger numbers of crows in areas where they have concentrated. Although, locally, trapping may show immediate and perceptible benefits, it is not an economical means of effecting a material reduction in the number of crows found over an extensive area or inhabiting a large roost.

Through the use of steel traps of No. 0 or No. 1 size, the jaws of which have been wrapped with cloth or rubber, crows may be captured uninjured and, after they have been killed, their bodies may be hung up in conspicuous places as a deterrent. Satisfactory sites for such trap sets are at vantage points near poultry yards to which crows have been habitually coming, or in the immediate vicinity of dummy nests containing a few hen's eggs, placed where passing crows will not overlook them.

Cage traps of the Australian type (fig. 6) may be used on lines of flight to and from winter roosts or in the vicinity of slaughterhouses or feed lots where crow concentrations have become objectionable. Cage traps, in particular, and steel traps, to a lesser degree, are consistently successful only during periods of severe weather, as when a heavy snowfall has covered much of the available food of these birds or when there is food scarcity from other causes. No fewer than 1,545 crows were captured in a single winter in three cage traps operated by two farmers in Oklahoma. Two of these traps were set in a hog-feeding lot to which the crows were regularly attracted and from which they pilfered considerable feed.

Cage traps of this type, which usually are constructed with ground dimensions of 8 to 10 feet and a height of 6 feet, have been used, with slight modifications, for the capture of a variety of birds, notably white-necked ravens, crows, magpies, and starlings. Trapping is most effective during the colder months, after the crops have been harvested and food is scarce. In some years successful results may be obtained as early as October and as late as March.

The trap is baited by placing slaughterhouse offal, rabbit carcasses, or other meat in the cage directly beneath the ladderlike opening. Some success has been obtained with milo heads, watermelons,

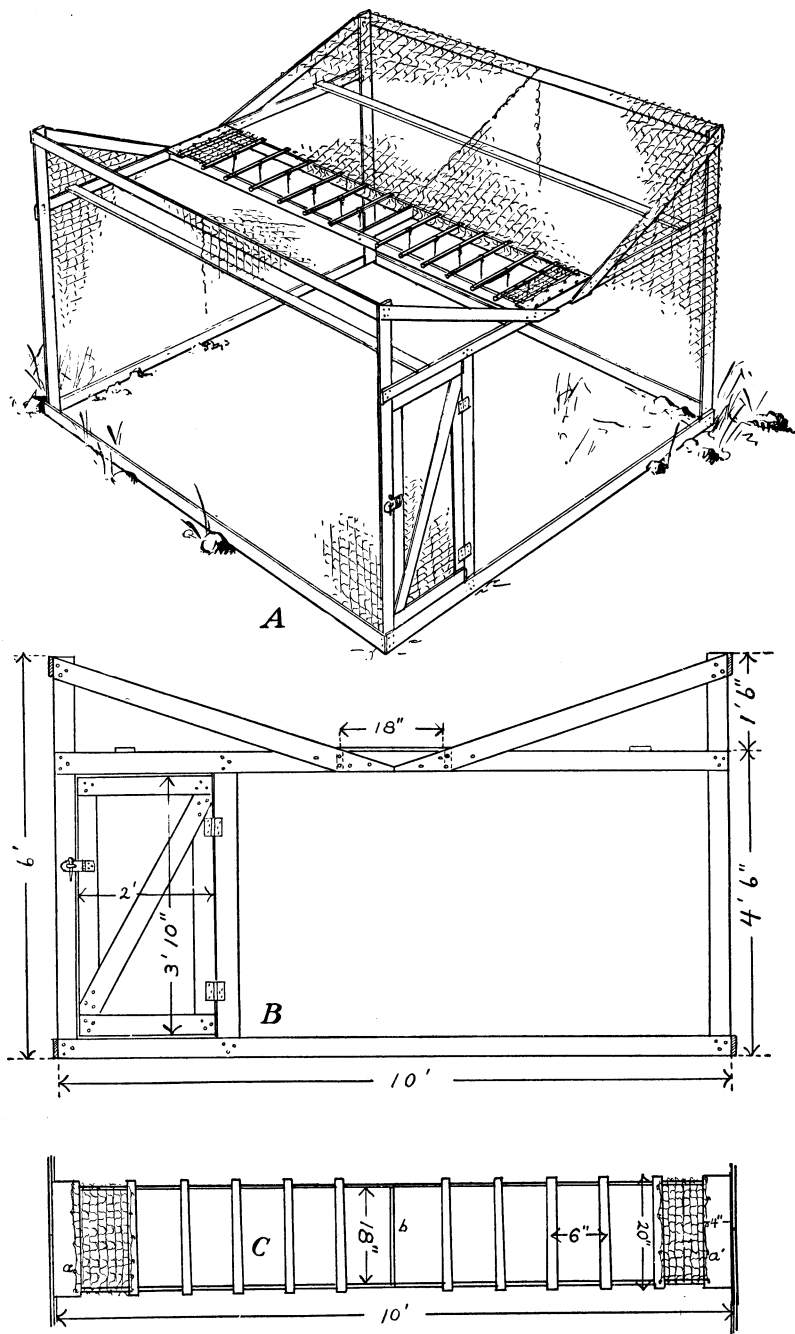


FIGURE 6.—Cage trap of Australian type, for capturing crows, and details of construction: *A*, View of completed trap; *B*, plan of "ladder" opening; *C*, end elevation.

and even garbage as bait, but such materials are less attractive to the bird than meat. After the first baiting, the trap should not be approached for at least 24 hours.

Once the birds begin to enter the trap, it should be visited daily and all birds removed except five or six freshly caught ones, which are to be left in the trap as decoys. As soon as the bait loses its fresh appearance, it should be replaced with fresh material.

The birds may be killed quickly and humanely by grasping the legs, wings, and tail tightly in the hand and striking the head sharply against a post or rock. The dead crows should be taken some distance from the trap so they will not act as a deterrent to others, and the trap and the surrounding area should be kept free of feathers and other litter.

SHOOTING

The unusual wariness of the crow has limited the effectiveness of firearms in reducing its numbers during daylight hours. These birds, however, are inclined to shun areas where the shotgun is frequently used; hence the deterrent effect is considerable. The use of crow decoys and crow calls has been resorted to with such success in attracting the birds within gunshot that these articles are now sold by dealers in sporting goods. A mounted owl placed in a conspicuous position within easy gunshot of the concealed hunter has also proved satisfactory in attracting crows to a point where they can be shot.

In combating small winter roosts of crows, attacks on several successive nights by a number of men with firearms will frequently cause the birds to move. At the same time, through proper organization of a crew of 8 or 10 men, a considerable kill may sometimes be made before the birds begin to leave the vicinity. Even when a roost has been removed, vigilance must be employed for some time thereafter to prevent its reestablishment. In dealing with larger winter roosts inhabited sometimes by more than 200,000 birds, something more drastic than gunfire is required, and the practice of bombing has been developed in some places to a high degree of efficiency.

BOMBING ROOSTS

Bombing, or blasting, winter crow roosts is an economical, although somewhat dangerous, method of reducing the number of roosting crows. Bombings have been carried out in Virginia, Illinois, Indiana, Michigan, Oklahoma, Idaho, California, and possibly in other States. In the main, these operations have been conducted by officials of the game and fish departments with personnel trained in the use of explosives. Such measures of control should not be undertaken by the average citizen, and the details of procedure and equipment used need not be described here.

The effectiveness of bombing depends largely on the concentration of birds in the immediate vicinity of the bombs at the moment of discharge. Sometimes a premature explosion or a sudden movement of the birds has resulted in complete failure of the attempt, but at other times phenomenal kills have been made. A careful count made by a representative of the Biological Survey indicated that more than 26,000 crows were killed when about 150 bombs were discharged at a roost in Oklahoma in the winter of 1937-38. The cost for materials was less than half a cent a bird. This may be regarded as better

than average efficiency and economy at the present stage of development of this process of crow control.

Crow bombing has a distinct utility in areas where excessive damage to late-maturing grain crops can be traced to birds of a nearby roost. Successful bombing will kill an appreciable portion of the roosting flock and cause a dispersal of the survivors; in either case local relief is obtained. As a procedure for the improvement of resident upland-game conditions, bombing is ineffective, because most of the crows found at winter roosts are summer breeders at points far to the north and therefore do not figure in local predator-prey relationships. What effect extensive winter bombings in Central or Southern States might have on wild-fowl production along the northern border of the crow's range is unknown. Not all crows nesting in the general area where wild fowl are produced and only a few of those breeding away from the immediate vicinity of nesting wild fowl can be looked upon as hazards to these game birds. The study of crow-waterfowl relationships (p. 9) has led to the conclusion that even complete elimination of the crow would improve nesting conditions on only part of the great area in which the bulk of the waterfowl are produced. When with this thought is coupled the knowledge that the killing of crows at winter roosts is not a selective process and results in the removal of birds that may or may not enter into the crow-waterfowl problem, the utility of winter bombing as a duck-conservation procedure becomes doubtful.

Although bombing as a crow-control measure has its advantages, some of its objectionable features should be mentioned. Needless to say, the preparing, handling, and discharging of 100 to 200 bombs, each containing a full stick of dynamite, are not occupations for the inexperienced. Serious injuries have been received from the accidental firing of bombs. Furthermore, from the time the bombs are set until they are discharged the area should be closely patrolled to prevent the intrusion of human beings or livestock. Unfortunately, this precaution is not always taken. The practice is also objectionable because many birds are crippled and survive for a time in the vicinity of the bombing unless crews are employed to dispatch them, a practice that is not always followed.

DESTROYING NESTS

In sections where woodlands are close to farmyards containing exposed nests and young chicks, the destruction of a few crows' nests will greatly lessen depredations on poultry. The success of this measure depends on the fact that most of the raids on poultry yards are made by crows in the attempt to get food for their young. The desirability of screening poultry and defensive as well as aggressive methods of control are discussed in Department of Agriculture Leaflet 96.

CROWS AS FOOD

Since bombing and competitive hunts have become more prevalent, the idea of using crows for human food has had a certain popular fancy. "Crow banquets" are not infrequent, and dressed crows have appeared in the markets of cities that are within short distances of ready and cheap sources of supply. Dressed crows have sold in Oklahoma markets for 19 cents each, and in Denver, Colo., they

have commanded a slightly higher price under the supposedly more attractive trade name "rook." In the vicinity of crow bombings, where thousands of freshly killed birds may be had merely for the labor involved in gathering and dressing them for sale, produce merchants have availed themselves of the opportunity. At present the sale of crows for food is merely a novelty, and no extensive or steady demand for the birds has yet been created.

SUMMARY

The crow is a bird whose size, almost omnivorous habits, and ability to survive under diverse environments enable it to do both notable good and harm. The influence of the race as a whole for good and harm in relation to agriculture appears to be about equally divided. Local conditions, however, greatly affect the economic status of the crow. For this reason hasty judgment as to its worth should not be rendered, lest the bird be persecuted in sections where it is actually aiding the farmer. Indiscriminate killing is not warranted, and even in areas where the crow is doing harm, often preventive measures suffice and permit the bird to continue its good work in the destruction of insects. Damage prevention includes the following:

1. Using coal tar or other deterrents on seed grain.
2. Scattering grain over fields where the crop is just sprouting.
3. Stretching twine about and across fields from poles placed at intervals.
4. Keeping hens and chicks in enclosed runs and screening poultry yards.
5. Using frightening devices and hanging dead bodies of crows in conspicuous places.

Where more drastic measures are necessary, killing even a few crows will intimidate survivors, and these will usually shun the area for some time. To this end strychnine has at times been employed, but, in conformity with a policy of limiting the use of poisons in bird control to situations where no other procedure is satisfactory, the use of strychnine, as well as that of the even more dangerous slow-acting poisons, is not recommended to the public. Accordingly greater emphasis is placed on the following combative methods of control:

1. Trapping—by means of carefully concealed steel traps baited with hen's eggs or by cage traps of larger size baited with carrion.
2. Destroying nests—a measure that will frequently stop the poultry-raiding activities of a pair of crows nesting nearby.
3. Shooting—the hunter being aided by the use of a crow call and, where possible, also by a mounted owl placed conspicuously on a pole. Several night attacks by men equipped with shotguns will frequently dislodge small objectionable winter roosts.
4. Bombing at large roosts—a procedure practiced in many States, usually supervised by the game and fish departments. Thousands of crows have been killed, and large roosts frequently have been destroyed or the birds forced to move out, thus reducing crop damage in the vicinity. Bombing is believed to have little or no effect on improvement of the resident upland game-bird crop, and its merit in the improvement of waterfowl conditions to the north is problematical.

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